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APPLIED SCIENCE RESEARCH LABORATORY  
UNIVERSITY OF CINCINNATI  
CINCINNATI 21, OHIO

PROGRESS REPORT NO. 6  
October 1, 1952 - November 30, 1952

ON

DEVELOPMENT OF NEW POLYMERS FOR AIRCRAFT APPLICATION

Navy Bu Aer Contract NOa(s) 52-090 c

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Work of:

John Adams  
Albert Haefner  
Henno Keskkula

Supervisors:

Charles E. Frank  
Walter Soller

Date: December 16, 1952

Approved:

*Walter Soller*  
Walter Soller  
Director

## Table of Contents

	Page
I. Summary	1
A. Chloroprene - Methacrylic Acid (C-MA) Copolymers	1
1. Curing Studies	1
2. Cornell Tests	1
3. Effect of Water Immersion	2
4. Creep Behavior of C-MA Copolymer	3
B. Chloroprene - Methacrylamide Copoly- mers	5
II. Program	6
III. Experimental	7
A. Chloroprene-Methacrylic Acid and Copolymers	7
1. Evaluation of Curing Agents	7
2. Cornell Test Panels	7
3. Water Immersion Tests- Preparation of Specimens	7
B. Chloroprene - Methacrylamide Copolymers	8
C. Chloroprene - Acrylonitrile Copolymers	12

## Summary

### A. Chloroprene-Methacrylic Acid (C-MA) Copolymers

#### 1. Curing Studies

In view of the promising results obtained in the last Cornell tests (see Report No. 5), considerable time during this period has been devoted to the further study of organic curing agents. A series of diamines, imines and polyhydroxyphenols now have been evaluated, allowing the films to cure 14 days at room temperature. In general, the films possessed good tensile strength and elongations, but showed higher permanent set than those cured with metal oxides. (see Tables I, II, and III) The most effective of the organic curing agents tested thus far include benzidine, o- and p-phenylenediamines, diphenylguanidine (DPG), dianisidine and 2-amino-4-nitrophenol.

#### 2. Cornell Tests

The tenth series of Cornell specimens comprising fourteen panels has been prepared and submitted for evaluation. (Table IV) The eleven C-MA topcoat panels were all air-cured with various diamines and/or DPG. Three of the panels employed a chloroprene-methacrylamide topcoat which has not been tested at Cornell previously. In the C-MA

series, the earlier lack of homogeneity and possible deleterious effects of the heat-cure have been eliminated. The tensile strength of the topcoats varies from 2900 to 5800 p.s.i.; therefore, a good indication of the effect of this property upon rain-erosion resistance should be obtained. Panel 10-A employing methacrylamide copolymer with an air-cure using Goodyear accelerator 983-C will give a comparison with a like C-MA cure tested in the previous ninth Cornell series.

### 3. Effect of Water Immersion

In view of the fact that C-MA copolymer coatings previously have failed through bubbling on the Cornell rain erosion tester, water immersion tests of the films have been continued. (see Report No. 5) Coatings approximately 5 mil thick were prepared on a standard C-MA primer. These coatings were kept at room temperature not less than a month before the immersion tests were conducted. (Table VI)

Upon immersion in water for 24 hours at 30°C, the films containing conventional rubber accelerators, and also catechol, para-toluidine and phenyl- $\beta$ -naphthylamine, showed some water absorption as indicated by the color change of the coating. This change, however, was reversible as the films acquired their original color on standing in air. Secondly, the adhesion between the topcoat and the primer was weakened on immersion.

The films which had given the lowest compliances in

the creep study also were best in apparent resistance toward water absorption. Films containing para-phenylene diamine, DADPM, benzidine, and diphenyl-guanidine retained their original color and were excellent in intercoat adhesion. These tests indicate that coatings of low water sensitivity can be obtained using diamines as curing agents at room temperature.

#### 4. The Creep Behaviour of C-MA Copolymers

In view of the previously reported failure to acquire correlation between creep behaviour and rain erosion data, (rain erosion series No. 9) lacquers tested for creep behaviour have been confined to the ones resulting in completely homogeneous films.

In connection with the study of promising air-curing agents, C-MA copolymer (AK-20) creep behaviour has been studied when cured with some 15 organic agents. (Figure 1) Also tensile properties, including elongation and ASTM permanent set have been determined. (Table VI)

The results from the creep tests seem to divide the organic agents into two groups. First, various diamines, diphenylguanidine, phloroglucinol and Goodyear Accelerator 938-C result in cured coatings after standing for 14 days. The cure probably results from salt formation between the carboxyl and the amino groups. The second class of substances, including most conventional accelerators, seem to act as plasticizers by increasing the compliance as compared with

pure gum stock.

Creep curve obtained with para-phenylenediamine cure has considerably lower compliance than the other diamines. This curve, however, will probably fall in line with the other diamines if equivalent molar quantities rather than equivalent weights are used.

A similarly effective cure has been realized with phloroglucinol. It is believed to be significant that the creep curve (compliance versus log time) is a straight line, (run No. 46) while diamines give a curve for the similar plot. Buchdahl and Nielsen<sup>1</sup> have indicated that for some elastomers, a change in slope of the creep curve (log compliance versus log time) indicates a change in molecular mechanism of creep during the experiment. Accordingly, it may be that different mechanisms of cure are indicated here by the different types of curves obtained. Further investigation of this is in progress.

In comparing the creep and tensile properties of a given system, it appears that a low compliance is associated with a low ASTM set. Less consistently, the tensile increases and elongation decreases as compliance decreases. (Table VI)

The effect of heat on C-MA copolymer gumstock was determined. Creep behaviour of the gum stock was studied after 1, 2, 6 and 26 hours heating at 120 degrees C. (Figure II) The corresponding tensile properties also were determined. (Table VII) It was of interest to note that no improvement

1. Rolf Buchdahl and Lawrence E. Nielsen, Journal of Applied Physics 22, 1344 (1951)

in tensile strength was realized on heating, while the compliance decreased as expected on increasing the time of bake.

E. Chloroprene - Methacrylamide Copolymers

Additional curing studies have been conducted on the chloroprene-methacrylamide copolymers with poly hydroxy aromatics. All provided reasonable but not outstanding high-temperature cures; the air cure results were not as high as with Goodyear Accelerator 983C.

In order to gain further insight into the nature of the copolymer, monomer relative reactivity ratios were determined both in solution and in emulsion. The results obtained were as follows: in solution at 50°C,  $r_c = 5.5 \pm 1.0$ ,  $r_m = 0.05 \pm .05$ ; in emulsion at 30°C,  $r_c = 20 \pm 10$ ,  $r_m = .03 \pm .03$ . The greater difference in reactivity observed in emulsion presumably results from the large difference in water solubility. From the observed reactivity values in emulsion both integral and differential distribution curves have been plotted for a 40 weight percent methacrylamide charge. These indicate considerable heterogeneity of composition; for a 60% conversion polymer, roughly 1/3 would contain no more than 3 to 4½ percent methacrylamide. 1/3 would contain 4½ to 9 percent, 1/6 would have a composition between 9 and 14 percent and the remainder would contain 14 to 29 percent.

Further investigations of the chloroprene-acrylonitrile copolymer have been conducted to study composition,

curing and reinforcement. Good tensile strengths have been observed up to 24 percent acrylonitrile. The highest tensile strength without reinforcement was observed at 24 percent acrylonitrile; at this composition, free films exhibited the following properties: tensile strength 3630 p.s.i.; elongation at break, 560 percent; permanent set 12 percent. Further improvement in tensile strength was observed with the addition of hard processing channel black. Twenty-five parts black raised the tensile strength to 4690 p.s.i. and decreased the elongation to 470 percent; the permanent set observed was 10 percent.

Various cures that proved successful for the methacrylamide copolymer were also tested for the acrylonitrile copolymer. Tensile strengths above 3000 p.s.i. were obtained for both an 8 part phloroglucinol cure and for the 6-2-2, Zimate, magnesia, sulfur cure. No room temperature cures were studied.

#### Program

Investigation of the air-cure formulations similar to those in the present report will be continued. Results of the 10th Cornell series should give an indication of the relative merits of the various curing agents and, thus, assist in the further development of optimum coating properties. Creep studies of the C-MA copolymers will be continued with the objective of relating fundamental polymer properties to rain erosion resistance. Additional investi-

gation of the properties of chloroprene-methacrylamide copolymers also is planned.

### Experimental

#### A. Chloroprene-methacrylic Acid Copolymers

##### 1. Evaluation of Curing Agents

The effectiveness of various organic curing agents on C-MA, Gates Neoprene and Hypalon S-2 coatings are summarized in tables I, II, and III.

##### 2. Cornell Test Panels

A new solvent system was employed in the preparation of the panels of the 10th Cornell series. (see Table IV) This 40-30-30 mixture by volume of methylisobutyl ketone, xylene and toluene seemed to dissolve the copolymer more quickly producing a nearly gel-free lacquer. Since the two monomers employed vary considerably in structure and physical properties, it seems reasonable that a ketone-aromatic hydrocarbon system is preferable to a mixed ketone system. This is further born out by the ready solubility of neoprene (100% chloroprene) in aromatic hydrocarbons.

##### 3. Water Immersion Tests - Preparation of Specimens

Three-S aluminum panels (5 x 8 cm) were carefully cleaned with cyclohexanone, and the standard C-MA primer applied in about 1 mil thickness. The primer was subsequently cured for four hours at 120°C.

The topcoat lacquer (C-MA copolymer AK-20) to which the proper curing agents were added in solution, was

applied by pouring a small amount of lacquer on the primer. The specimens were air dried on level steel plates.

B. Chloroprene-Methacrylamide Copolymers

Both oven and room temperature cures were studied with a 10 percent methacrylamide copolymer at 61 percent conversion modified with 0.14 parts dodecyl mercaptan. The results are presented in Table VIII.

Table VIII

Curing Variations for the Chloroprene-Methacrylamide Copolymer

<u>Agent</u>	<u>Parts</u>	<u>Bake</u>	<u>Tensile strength, p.s.i.</u>	
			<u>10 days</u>	<u>20 days</u>
983c	0.9cc/gm	2 hrs @120°C	3210	3400
Catechol	8	2 hrs @120°C	3530	3660
Pyrogallol	8	2 hrs @120°C	3790	4110
Pyrogallol	8	air cure	2680	2900
Phloroglucinol	8	2 hrs @120°C	3890	3520
Phloroglucinol	8	air cure	2260	2280

<u>Agent</u>	<u>Elongation Break, %</u>	<u>ASTM Set</u>
983c	900	15½
Catechol	800	9½
Pyrogallol	640	4½
Pyrogallol	850	9
Phloroglucinol	530	5
Phloroglucinol	720	10

Neither air cure was comparable to that previously obtained with Goodyear Accelerator 983c. Several of the temperature cures approached the tensile strength obtained with the 6-2-2, zimate, magnesia, sulfur cure.

To study the bulk reactivity ratios for the chloroprene-methacrylamide system, polymerizations were conducted in

methyl ethyl ketone at 50°C with 0.5 part benzoyl peroxide as initiator. After a polymerization time of 46 hours, the monomeric chloroprene was stripped off under vacuum. Residues were dissolved in methyl ethyl ketone and precipitated by pouring into an excess of water. This solution and precipitation was repeated to insure removal of the methacrylamide monomer. Polymers were dried to constant weight in vacuo at 45-50°C. and analyzed for chloride. The results are tabulated below.

Table IX

Solution Polymerization Data for the Chloroprene-Methacrylamide Copolymer

Wt. % Methacrylamide in charge	Conversion %	Wt. % Methacrylamide in Copolymer
19.4	9.3	5.7
39.0	10.0	12.5
59.0	8.5	18.5
69.1	6.8	24.5
79.4	4.8	35.9
89.6	5.0	61.8

From this data, reactivity ratios in solution were calculated using the method of intersections developed by Mayo and Lewis.<sup>2</sup> Conversion was corrected for by the following equation which was also developed by these workers.

$$r_2 = \frac{\log \frac{M_2^0}{M_2} - \frac{1}{P} \log \frac{1-P \frac{M_1}{M_2}}{1-P \frac{M_1^0}{M_2^0}}}{\log \frac{M_1^0}{M_1} + \log \frac{1-P \frac{M_1}{M_2}}{1-P \frac{M_1^0}{M_2^0}}}$$

2. F.R. Mayo and F.M. Lewis, J Am Chem Soc 66, 1594 (1944)

where  $P = (1-r_1)/(1-r_2)$ ,  $M_1$  and  $M_2$  are the moles of monomers unpolymerized at the end of the reaction and  $M_1^0$  and  $M_2^0$  are the moles of monomers charged.

The ratios as determined in solution were  $5.5 \pm 0.5$  for chloroprene and  $0.05 \pm 0.05$  for methacrylamide. These same values should also hold in bulk polymerization.

For emulsion system, a series of low conversion polymers was also prepared for reactivity calculation, but analyses proved inconsistent, probably as a result of errors introduced by the short-stop and other ingredients of the emulsion recipe. Calculations were then based on the following data obtained mostly at higher conversions.

Table X  
Composition-Conversion Data in Emulsion for Reactivity Calculations

<u>Wt. % Methacrylamide in charge</u>	<u>Conversion, %</u>	<u>Wt. % Methacrylamide in polymer</u>
15	68	2.5
25	68	2.6
30	68	3.7
40	34	4.9
40	61	7.9
50	51	10.5
70	31	17.4

This data is in conformity with the reactivity of  $20 \pm 10$  for chloroprene and  $.03 \pm .03$  for methacrylamide. It should be noted that in this work reactivity ratios in emulsion have been interpreted following the treatment of Wall.<sup>3</sup>

3. Wall, F.T., J Am Chem Soc. 72, 476, 4769 (1950)

They differ from the corresponding ratios in bulk by the distribution coefficients of the monomers between the phases present and are consequently a function of the monomer-water ratio. The reactivities determined here were for a 1:2 monomer to water ratio.

The meaning of these reactivity ratios in terms of polymer compositions is described in Figure 3 and 4. Both were calculated for a charge ratio of 40 weight percent methacrylamide (41 mol percent). In Figure 3 both instantaneous and average polymer composition are plotted as a function of conversion; the average composition curve was calculated using the following equation of Mayo and Lewis:

$$\frac{M_2}{M_2^0} = \left( \frac{M_1}{M_1^0} \right)^{\frac{1}{r_2}} \quad r_2 = \frac{M_2^0/M_1^0 + 1}{M_1 + M_2^0/M_1^0}$$

The instantaneous composition curve was obtained as the slope of a plot of moles of methacrylamide in the polymer as a function of the moles of polymer. Instantaneous composition curves have been utilized by Skeist<sup>4</sup> as an indication of copolymer heterogeneity; the difference in compositions at 25 and 75 percent conversions provides a numerical measure of the dispersion of composition of the copolymer. It will be seen that the spread from 5 to 99 percent methacrylamide is indicative of considerable composition dispersion.

4. Skeist, I., J Am Chem Soc 68, 1731 (1945)

The distribution of composition is brought out more strikingly in the differential distribution curve, Figure 4; this was constructed from the slope of the instantaneous composition curve plotted against this composition. The area under this differential distribution curve between any two instantaneous compositions represents the fraction of the monomer charge that has been converted to polymer of that composition range. From this curve, it is apparent that for a 60 percent conversion polymer, roughly 1/3 of the polymer has a composition between 3 and 4½ percent methacrylamide, another 1/3 between 4½ and 9 percent, 1/6 between 9 and 14 percent and the remaining 1/6 between 14 and 29 percent.

#### C. Chloroprene-Acrylonitrile Copolymers

A series of chloroprene-acrylonitrile copolymers has been prepared without mercaptan modification to furnish further information on the effect of composition on physical properties. The results are tabulated below using a cure of 5 parts zinc oxide, 4 parts magnesia, and 2 parts Ethyl Selenac and a bake of 3 hours at 140°C.

Table XI

Effect of Composition on Conversion for Chloroprene-Acrylonitrile Copolymers

Wt. % Acrylonitrile in copolymer	Tensile Strength p.s.i.	Elong. at Break, %	ASTM Set.
14.7	3290	750	3½
17.2	3300	630	4½
18.6	3270	660	6
19.3	3330	670	8
19.6	3340	600	10
24.2	3630	560	12
28.4	3040	380	17

Although highest tensile strengths were observed in the vicinity of 24 percent acrylonitrile, permanent set was much improved at lower acrylonitrile contents.

Additional curing experiments were conducted to see if the mixed oxide - Ethyl Selenac cure can be improved upon. Results are summarized in Table XII.

Table XII

Miscellaneous Curing Studies with the Chloroprene Acrylonitrile Copolymer

<u>Agent</u>	<u>Bake</u>	<u>Tensile Strength psi</u>	<u>Elong. at Break, %</u>	<u>ASTM Set</u>
5 ZnO 4 MgO 2 Et. Selenac	3 hr @140	3200	600	10
6 Et. Zimate 2 MgO 2 S	2 hr @120	2830	-	-
6 Et. Zimate 2 MgO 2 S	3 hr @140	3300	720	13
Goodyear 983c .9 cc/gm	2 hr @120	1910	915	21
8 Phloroglucinol	2 hr @120	3510	-	-
8 Pyrogallol	2 hr @120	2440	850	11
4 MgO 8 Et. Selenac	2 hr @120	2610	670	11

Physical properties appeared to be effected by the conditioning period after bake. On the basis of the following data, the tensile strength of the phloroglucinol cure decreases with time whereas it improves for both the 6-2-2- cure and for the mixed oxide-Ethyl Selenac Cure.

Table XIII

Effect of Conditioning Time on Tensile Strength

<u>Agent</u>	<u>Bake</u>	<u>Tensile Strength, psi</u>		
		<u>4 days</u>	<u>11 days</u>	<u>18 days</u>
5 ZnO 4 MgO 2 Et. Selenac	3 hrs @140°C	2920	3120	3200
6 Et. Zimate 2 MgO 2 S	2 hrs @120°C	2180	2780	2830
8 Phloroglucinol	2 hrs @120°C.	3510	3260	2840

The highest tensile strengths for the chloroprene-acrylonitrile copolymers were obtained with carbon black reinforced films. Hard processing channel black was milled into an 18.6 percent acrylonitrile copolymer in amounts up to 25 parts. The results are tabulated below:

Table XIV

Effect of Carbon Black Loading on Physical Properties for Chloroprene-Acrylonitrile Copolymers

<u>Parts HPC Black</u>	<u>Tensile Strength psi</u>	<u>Elong. at Break%</u>	<u>ASTM Set</u>
0	3130	650	5 $\frac{1}{2}$
2	3600	700	7 $\frac{1}{2}$
5	3740	700	7 $\frac{1}{2}$
10	3920	610	8 $\frac{1}{2}$
20	4650	580	10
25	4690	470	10

High carbon black loading is detrimental to both elongation at break and permanent set.

Table I

Air-Cure of C-MA<sup>1</sup> Lacquers by Organic Curing Agents

<u>Curing Agent</u>	<u>Amount</u>	<u>Tensile Strength at Break, psi</u>
Benzidine	6 pts.	4370
	10 pts.	4640
Benzidine plus DPG	3 pts. plus 3 pts.	4500
DPG plus 1 pt paraffin	6 pts.	3300
O-Aminophenol	6 pts.	2770
Phloroglucinol	6 pts.	2400
2-aminopyridine	6 pts.	2350
Hexamethylene tetramine	6 pts.	3200
Dianisidine	6 pts.	3500
o-phenylene diamine	6 pts.	2900
p-phenylene diamine	6 pts.	5780
2-aminobenzothiazole	6 pts.	2250
2-aminoazoanisole	6 pts.	2030
2-amino-4-nitrophenol	6 pts.	3980
DADPM	6 pts.	3200
Toluidine	6 pts.	1790
DPG	6 pts.	4400

Table II

Air-Cure of Gates Coating by Organic Curing Agents

<u>Curing Agent</u>	<u>Amount</u>	<u>Tensile Strength at Break, psi</u>
Dianisidine	6 pts.	1700
DPG	6 pts.	2000
DADPM	6 pts.	2050
o-phenylene diamine	6 pts.	3030
p-phenylene diamine	6 pts.	3200

Table III

Air-Cure of Hypalon S-2 by Organic Curing Agents

<u>Curing Agent</u>	<u>Amount</u>	<u>Tensile Strength at Break, psi</u>
DPG plus MBT	6 pts. plus 3 pts.	1730
DPG plus MBT plus DADPM	3 pts. plus 3 pts. plus 3 pts.	2810

Table IV

A.S.R.L. No.	Topcoat Composition	Curing Agents	Curing Conditions	Tensile Strength	Topcoat Thickness
10-A	Chloroprene-methacryl- amide copolymer	.9 ml 983-c/gm polymer	Room Temp.	3060	ca. 3
10-B	"	6 pts Et.Zimate plus	2 hrs @120°C	3520	ca. 3
10-C	"	2 pts MgO+2 pts Sulfur	2 hrs @120°C	4150	ca. 3
10-D	C-MA A-37 <sup>2</sup>	6 pts o-phenylene diamine	Room Temp.	5730	ca. 8.5-9.0
10-E	"	6 pts DPG	"	4400	ca. 8
10-F	"	6 pts DPG plus 0.5pt paraffin	"	ca. 3600	ca. 3
10-G	"	3 pts DPG plus 3 pts Benzidine	"	4500	ca. 3
10-H	"	6 pts DADPM	"	3230	ca. 3
10-I	Gates <sup>3</sup>	6 pts o-phenylene diamine	"	3030	ca. 3
10-J	Hypalon S-2 <sup>4</sup>	3 pts DPG+3 pts DADPM+	"		
10-K	Gates	3 pts MBT	"	2810	ca. 10
10-L	CMA A-37	6 pts o-phenylene diamine	"	3200	ca. 9.0-9.5
10-M	"	6 pts Benzidine	"	4370	ca. 7.5
10-N	"	10 pts Benzidine	"	4640	ca. 8
	"	6 pts o-phenylene diamine	"	2900	ca. 3

Notes

1. 10% methacrylamide at 62% conversion
2. Chloroprene-methacrylic acid copolymer of 55.04% conversion and an acid content of 12.7%
3. Gates Engineering Company's commercial polymer lacquer N-79
4. Dupont's chlorosulfonated polythene polymer dissolved in methylethyl ketone and toluene.

Table V  
Immersion of C-MA Coatings

<u>Specimen</u>	<u>Agent 5 parts</u>	<u>Cond. of coating before immersion*</u>	<u>Cond. of coating after immersion for 24 hrs at 30°C water**</u>
D	Thionex	1	1
E	Goodyear Acc.903-C	1***	1
F	Methyl tuads	1	1
G	Ethyl Selenac	1	1
H	DADPM	3	3
I	Catechol	1	2
J	o-aminophenol	2	2
K	dianisidine	3	2-3
L	Diphenylguanidine	3	2-3
M	Phloroglucinol	2	2
N	Phenyl-B-naphthyl- amine	1	1-2
O	p-phenylene-diamine	3	3
P	benzidine	3	3
Q	$\beta$ -nitroso naphthol	2-3	2
R	p-toluidine	1	1

- \*1. Film tacky - fingerprints remain on coating; good primer topcoat adhesion.
- 2. Film somewhat tacky, and does not retain gloss on rubbing.
- 3. Films free of tack and reasonably glossy.

- \*\*1. Films turned to different shades of green; adhesion failure between topcoat and primer can be initiated by rubbing with finger.
- 2. Some discoloration of the coating; hard to initiate adhesion failure.
- 3. No apparent discoloration; good inter-coat adhesion.

\*\*\*Methyl tuads crystallized out in the film as viewed with a 50 X microscope.

Table VI

Effect of Organic Agents on C-MA copolymer (AK-20)

Specimen	Run No.	Organic Agent 5 parts	Tensile psi	Elong. %	A.S.T.M. Set, %	1 min. Recovery, %
A	29	Acc 808 - 10 parts	1490	1580	57	13
B	30	Captax	1370	1550	83	10
C	31	Altax	1350	1650	78	7
D	32	Thionex	1570	1500	65	6
E	34	Acc 938-C-Goodyear	1590	1250	51	6
F	36	Methyl tuads	1310	1300	66	6
G	37	Ethyl Selenac	1450	1420	72	5
H	39	DADPM	2620	1170	36	5
I	42	Catechol	1630	1300	69	6
J	43	o-amino phenol.	1720	1300	68	5
K	44	dianisidine	2660	1260	44	4
L	45	DPG (diphenyl- guanidine)	2240	1160	64	4
M	46	Phloroglucinol	2700	1240	45	3
N	48	Phenyl- $\beta$ -naphthylamine	1960	1400	65	5
O	49	p-phenylene-diamine	5430	990	26	5
P	50	Benzidine base	3770	1020	35	4
Q	51	$\beta$ -nitroso naphthol	1500	1240	70	5
R	52	p-toluidine	2280	1300	64	5

Table VII

Effect of Heat on C-MA Copolymer Gumstock (AK-20)

Run No.	Cure	Tensile psi	Elong. %	A.S.T.M. Set, %	1 min. Recovery, %
38	14 days, air cure	1565	1420	74	6
40	1 hr. 120°C	1700	1360	45	
41	2 hrs. 120°C	1680	1210	35	
33	6 hrs. 120°C	1670	1060	15	
35	26 hrs. 120°C	1350	890	8	

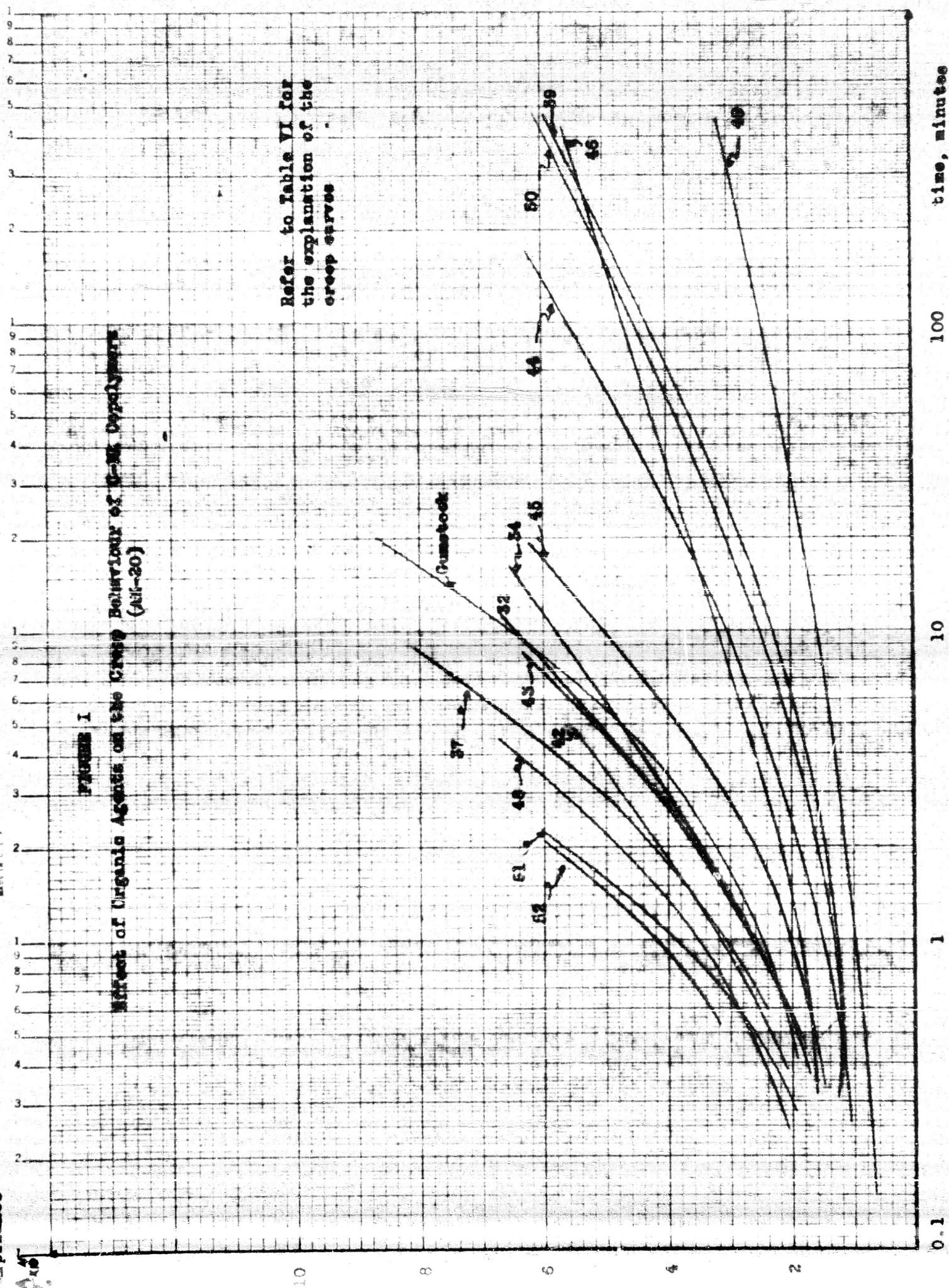
Compliance

49.47  
 50.10

FIGURE 1

Effect of Organic Agents on the Creep Behaviour of U-Mg Depositions  
 (XII-20)

Refer to Table VI for  
 the explanation of the  
 creep curves



time, minutes

359-81  
 Semi-Logarithmic, 4 Cycles X 10 to the inch  
 2 1/2 inch lines included  
 MADE IN U.S.A.

Compliance

$\frac{A \Delta}{S L_c}$

FIGURE II

EFFECT OF HEAT ON U-MA COPOLYMER ELASTOMER (AL-25)

Cure at 120°C  
 Refer to Table III

0 hrs

1 hr

5 hrs

5 hrs

20 hrs

time, minutes

100

10

1

0.1

Fig. 3

COMPOSITION-CONVERSION CURVES

FOR CHLOROPRENE-METHACRYLAMIDE COPOLYMER

Monomer Charge:

41 Mol % Methacrylamide

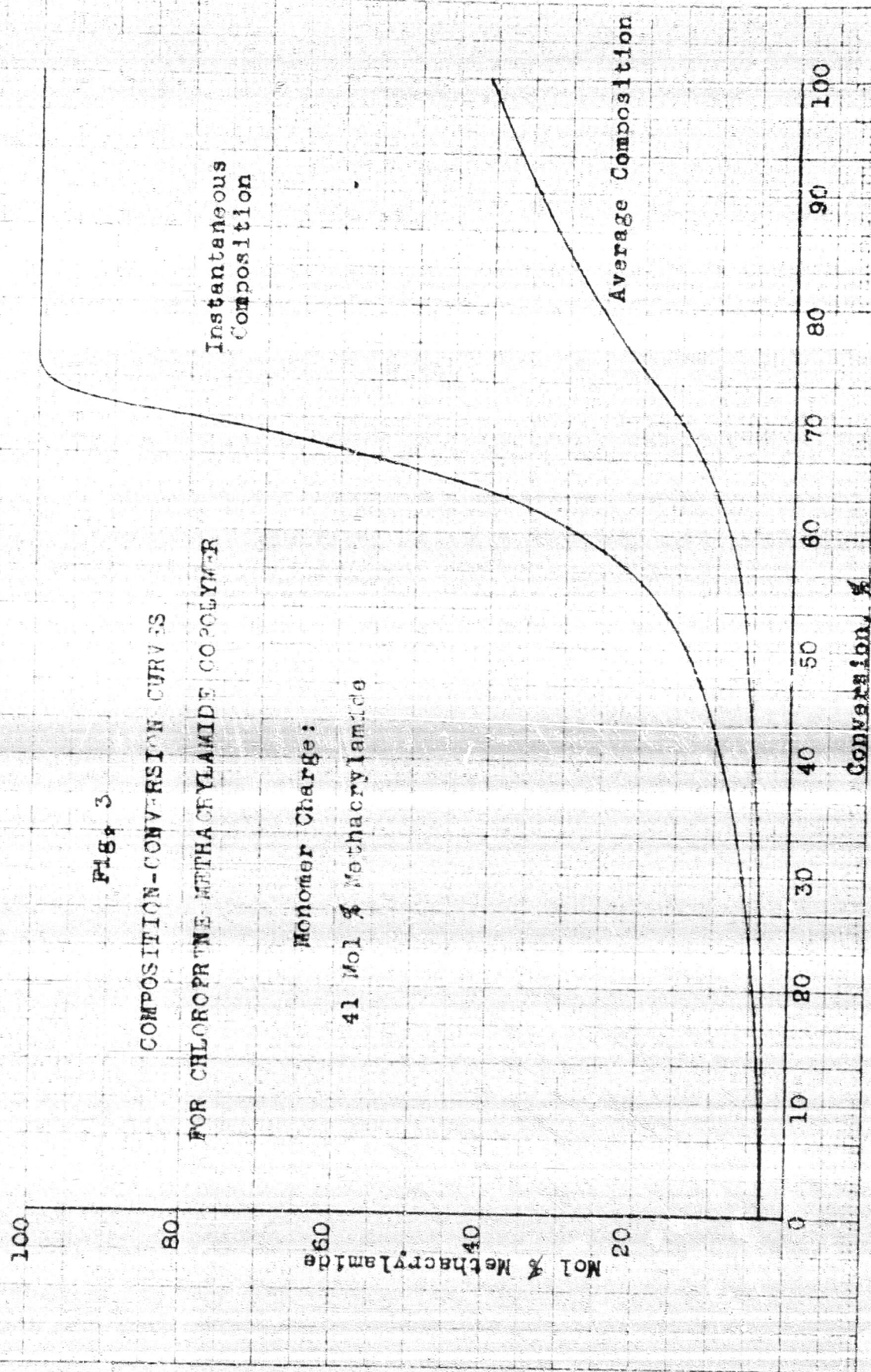


Fig. 4  
DIFFERENTIAL COMPOSITION DISTRIBUTION CURVE  
FOR CHLOROPRENE-METHACRYLAMIDE COPOLYMER

Monomer Charge:

41 Mol % Methacrylamide

